SECTION 10

FISH HEALTH AND CONDITION ASSESSMENT METHODS[1]

10.1 Introduction

10.1.1 The fish health and condition assessment methods provide relatively simple and rapid indication of how well fish live in their environment. They are manifestations of biochemical and physiological alterations expressed at the organism level. Goede and Barton (1990) and Goede (1992) review various types of condition indices that can be used to assess stress in fish, and they also describe an empirical necropsy-based system of organ and tissue indices that provides a fish health and condition profile of fish populations. External aspects, blood parameters, and the normal appearances of internal vital organs are assumed to indicate that a fish population is in harmony with its environment, or if the fish have been challenged, that the animals have not been stressed enough to cause obvious structural changes. When the necropsy system is applied in the field, departure from normal growth, bioenergetic state, and general homeostasis can be detected, as well as the presence of infectious agents in fish. Advantages of these methods over physiological monitoring or community analyses are that they are simple to use, requires little training, and does not need costly, sophisticated equipment. The fish health and condition assessment could be used routinely in research, culture, management, and regulatory programs to establish a data base for evaluating whether a fish population is coping successfully with its environment.

10.1.2 Novotny and Beeman (1990) evaluated the fish health and condition assessment methods on juvenile chinook salmon (*Oncorhynchus tshawytscha*) that were reared in net pens in the Columbia River, Washington, and they found the procedures were efficient in assessing the condition of fish held under various rearing conditions. They, furthermore, concluded that the simplicity of the methods makes them useful for monitoring fish in culture facilities and fish from wild stocks. These methods are meant to be used by investigators who routinely work in the field and for determining the general health and condition of a group of fish.

10.1.3 It is important that the investigator be able to use the minimum of equipment needed for these methods and to be able to recognize gross appearance or differences of systems in tissues and organs. The investigator does not specifically have to be able to diagnose the cause or causes of the condition. If a departure from normal condition is evident in a significant proportion of the fish population, it is appropriate that a specialist be called to help determine the cause of the variation.

10.1.4 A list of equipment and materials for the fish health and condition assessment is found in Table 1.

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[1]Adapted from Goede and Barton (1990) and Goede (1992).

TABLE 1. EQUIPMENT AND MATERIALS FOR FISH HEALTH AND CONDITION ASSESSMENT

- Microhematocrit Centrifuge
- Microhematocrit tubes[a,b]
- Critoseal clay to seal hematocrit tubes
- Microhematocrit tube reader
- 1.0 percent sodium or ammonia heparin solution
- Hand held serum protein refractometer
- Lens paper
- Bunsen Burner to sharpen hematocrit tubes
- Sharp/blunt scissors
- Dissecting forceps (preferably a small "mouse tooth type")
- MS-222 or comparable anesthetic[c]
- Metric scale to weigh individual fish
- Fish measuring board
- Hand held magnifying glasses for small fish
- Buckets and tubs to handle fish
- Calculators with standard deviation button

Heart puncture:

[a]Using capillary tubes: Sharpen capillary tubes and re-heparinize sharpened end at least 1/3 to 1/2 of tube.

[b]Heparin:

Use 0.1 gm of heparin to 10 mL distilled water. Fill capillary tube 1/3 to 1/2, then drain back into heparin solution. This solution can be reused again for rest of tubes. Remove all heparin from tubes and dry tubes overnight.

[c]MS-222 Mixture:

To incapacitate but not kill. A solution in excess of 50 mg/L (ppm) MS-222 is recommended. Use 4 times this amount for lethal dosage.

10.2 Sampling and Collection of Fish

10.2.1 The desired sample size for this procedure is 20 fish of the same species. When working with free-ranging populations, it is not always easy to obtain fish. In the field, the samples often are collected from fish captured in routine netting or electrofishing operations. In some sampling situations 20 fish of the same species might be difficult to collect. In this circumstance the investigator must work with what is caught.

10.2.2 The composition of the fish sampled (e.g., age class, length grouping, etc.) depends upon the data quality objectives (DQOs) of the investigation and upon what fish are available (see Section 2, Quality Assurance and Quality Control).

10.3 Handling of Fish

10.3.1 The ideal collection is taken alive and handled carefully until they can be anesthetized. The fish should be immobilized shortly after capture with an appropriate anesthetic, e.g., tricaine MS-222 (see Table 1).

10.4 Sampling and Reading of Blood

10.4.1 Blood should be collected by cardiac puncture with a sharpened, heparinized microhematocrit tube. If blood is needed for purposes in addition to those of this procedure, a larger volume can be sampled with a syringe and needle from the caudal vasculature. The microhematocrit tube can then be filled from that volume with the syringe. The tube, once filled, is plugged on one end using a commercial clay, prepared and sold for that purpose. It is advised that you place the filled tubes upright in a rack with numbered holes to await placement into a centrifuge. Every effort should be made to keep the tubes in order so that they can be accurately matched to the fish from which they were taken. The tubes are then placed in the numbered slots of a microhematocrit centrifuge and spun for five minutes. A typical microhematocrit centrifuge develops approximately 13,000 G. Erythrocytes (red blood cells) have been shown to "swell" when exposed to carbon dioxide. Thus, it is important that the tubes be spun within one hour of sampling. Once the tubes have been centrifuged they can be transported and read in a more convenient location but they should be read within two hours and definitely before the plasma begins to coagulate. Once the blood fractions have been separated by centrifuging, you can remove the tubes and place them again in the numbered rack. Always keep them in the order in which they were collected so they can be matched with the individual fish from which they were collected. The tubes can be kept until later or one can proceed to read the hematocrit, leucocrit, and plasma protein.

10.4.2 Hematocrit is the packed red cell volume of the blood and is expressed as a percentage of the total column. It is obtained by placing the centrifuged tubes on a microhematocrit reader. These are available in several styles and costs but the simple plastic reader cards containing a nomograph are preferred. The tube is placed on the card so that the bottom of the red (erythrocytes) portion of the column is at the zero line and the meniscus of the clear plasma portion of the column is on one hundred percent. The

location of the top of the red portion indicates the volume percentage of red blood cells or hematocrit.

10.4.3 There is usually a small "buffy or gray" zone just above the red zone. This is composed of the leucocytes or white blood cells and is used to estimate the leucocrit or percent leucocytes in the packed column. The card reader can be used to read this, and a small magnifying glass is helpful.

10.4.4 Next, the protein content of the plasma is determined. This is done by carefully breaking the hematocrit tube just above the "buffy" zone to obtain only the clear plasma fraction. Be sure that there are no small glass fragments on the broken end and then express the clear plasma onto the glass surface of the hand-held protein refractometer. Read the weight/volume percent of protein. The refractometer must be calibrated before use. To do this, place a few drops of distilled water on the prism surface and adjust the boundary line to the "w" or "wt" mark with the adjusting screw. Some instruments have a thumbscrew and some require a small screwdriver. The investigator should consult the manual supplied with the unit in question. The instrument should be cleaned between readings with lens paper to avoid scratching the surface. The surface should be cleaned with water and dried with lens paper after every use.

10.5 Length and Weight Measurements

10.5.1 The lengths and weights can be measured immediately after the blood samples have been collected for hematocrit determinations.

10.5.2 The total length of each fish should be determined in millimeters and the weight in grams. This is fairly straight forward but might be pointed out that the length and weight were initially included in the procedure to see if there was any correlation between fish size and the other parameters.

10.5.3 If it is desired to obtain an accurate estimate of size of the fish in the population, more lengths and weights should be taken through non-lethal sampling. The computer program, discussed later, will accommodate 60 fish.

10.6 External Examination

10.6.1 When the fish (Figure 1. External features of a composite fish) are laid out in front of you it is the best time to make general observations about the fish. Record general remarks about fins, skin, and other external features before you begin the specific observation of particular organs and systems. Important conditions to note are deformities, scale loss, and external parasites. These observations are carried as remarks in the data base. It must be noted here that primary observations included in this procedure were intended to permit some inference with respect to health and condition of the fish. This is only one aspect of "quality". Observations relative to esthetics are included as remarks only. Fish species (e.g., Catostomidae, Cyprinidae) develop cornified epithelial tubercles and engage in nuptial bouts. If external lesions or scars are observed in some specimens, the possibility of external anomalies related to spawning behavior should be noted.

10.6.2 Begin the observations as outlined in the classification system (Table 2). Be sure to record all observations using the abbreviations or codes listed on the classification scheme. This is necessary for subsequent entry into the computer program (see AUSUM PROGRAM USE, page 270). If the observation does not seem to fit any of the listed categories, list it as OT which indicates "other". If you use this category be sure to describe it in the remarks column. It is much easier for the recorder if you proceed routinely in the same order laid out on the fish necropsy (postmortem examination) worksheet (Figure 2). There are many systematic approaches to the order of the procedures, but Goede (1992) has found it more efficient to "open" all of the fish first with the use of sharp/blunt scissors by making a ventral cut from the anal vent forward to the pectoral girdle, cutting closely to one side of the pelvic girdle. A short distance of the "hind gut" is opened with this first cut to permit later observation. Do not insert the scissors so far that the internal organs are damaged. The fish are opened and laid down in front, in proper order, to wait the final inspection.

10.6.3 Take into consideration the circumstances of the collection. If the fish were collected dead, you must be aware of the often subtle differences this can make in appearance of organs and tissues while still permitting valid observation within the context of this procedure. A photographic, colored atlas (Goede, 1988) of necropsy classification categories has been prepared and may be obtained from Ronald W. Goede, Utah Division of Wildlife Resources, Fisheries Experiment Station, 1465 West 200 North, Logan, Ut. 84321-6233. The cost of the atlas is $80.00.

10.7 **External Organs**

10.7.1 Eyes

10.7.1.1. Normal (N) - no aberrations in evidence. Good "clear" eyes.

10.7.1.2 Exopthalmia (E1 or E2) - Swollen, protruding eye. More commonly referred to as "popeye". It is coded as E1 or E2. This refers to the presence of exopthalmia in one eye or two eyes.

10.7.1.3 Hemorrhagic (H1 or H2) - Refers to bleeding in the eye. "Blind" (B1 or B2) - This is a very graphic category and you need not know whether the eye is functionally blind. It generally refers to opaque eyes, and the opacity is not important here.

10.7.1.4 "Missing" (M1 or M2) - An eye is actually missing from the fish.

10.7.1.5 "Other" (OT) - Any manifestations which do not "fit" the above. Describe in the remarks column.

10.7.2 Gills

10.7.2.1 Normal (N) - no apparent aberrations in gills. Be very careful in this observation. The gill can easily be effected by the manner in which the fish is handled during and after collecting.

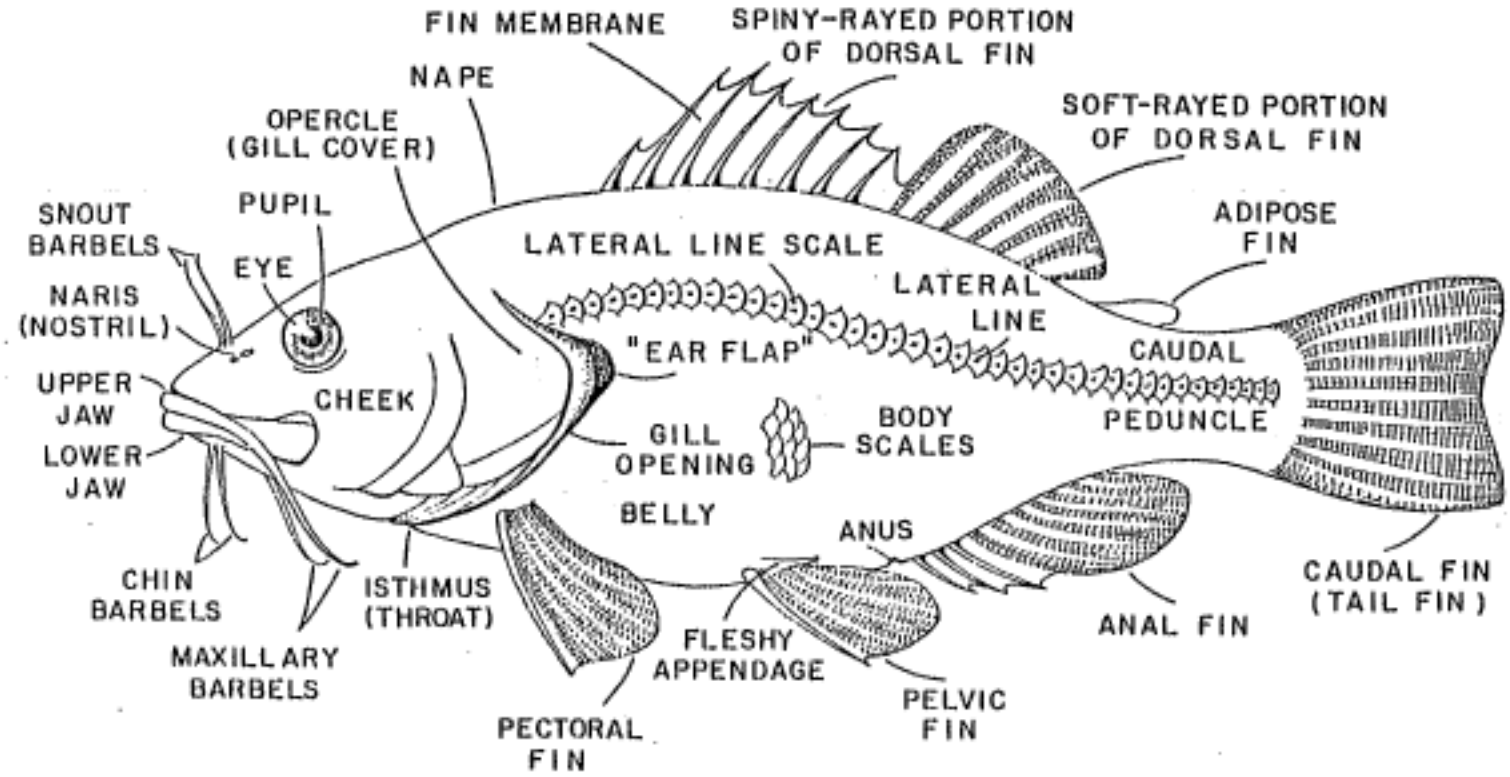

Figure 1. External features of a composite fish. From Lagler (1962), Atlas of Fish Anatomy, Plate 1, Michigan Fisheries No. 5, Department of Fisheries, School of Natural Resources, The University of Michigan, Ann Arbor, MI.

TABLE 2. NECROPSY CLASSIFICATION OUTLINE

Length:	Total length in millimeters
Weight:	Weight in grams
Ktl:	$= \frac{W \times 10^5}{L^3}$ See Subsection 10.9.
Eyes:	Normal (N), Exopthalmia (E1, E2), Hemorrhagic (H1, H2), Blind (B1, B2), Missing (M1, M2), Other (OT)
Gills:	Normal (N), Frayed (F), Clubbed (C), Marginate (M), Pale (P), Other (OT)
Pseudobranch:	Normal (N), Swollen (S), Lithic (L), Swollen and Lithic (S&L), Inflamed (I), Other (OT)
Thymus:	No Hemorrhage (0), Mild Hemorrhage (1), Severe Hemorrhage (2)
Fins:	No active erosion or previous erosion healed over (0), Mild active erosion with no bleeding (1), Severe active erosion with hemorrhage and/or secondary infection (2)
Opercles:	No shortening (0), Mild shortening (1), Severe shortening (2)
Mesentery Fat:	Internal body fat expressed with regard to amount present: 0 - None 1 - Little, where less than 50% of each cecum is covered 2 - 50% of each cecum is covered 3 - More than 50% of each cecum is covered 4 - Ceca are completely covered by large amount of fat
Spleen:	Black (B), Red (R), Granular (G), Nodular (NO), Enlarge (E), Other (OT)
Hind Gut:	No inflammation (0), Mild inflammation (1), Severe inflammation (2)
Kidney:	Normal (N), Swollen (S), Mottled (M), Granular (G), Urolithic (U), Other (OT)
Liver:	Red (A), Light red (B), "Fatty" liver, "Coffee with cream" color (C), Nodules in liver (D), Focal discoloration (E), General discoloration (F), Other (OT)

TABLE 2. NECROPSY CLASSIFICATION OUTLINE (CONTINUED)

Bile:	0 - Yellow or straw color, bladder empty or partially full 1 - Yellow or straw color, bladder full, distended 2 - Light green to "grass" green 3 - Dark green to dark blue-green	
Blood:	Hematocrit -	Volume of red blood cell (erythrocytes) expressed as percent of total blood volume. "Buffy" zone of the packed cell column.
	Leucocrit -	Volume of white blood cells (leucocytes) expressed as percent of total blood volume. "Buffy" zone of the packed cell column.
	Plasma Protein -	Amount of protein plasma, expressed as gram percent (grams per 100 mL).

Fish Necropsies

Wildlife Resources
2/91 FES-25

Date_____ Unit_____ Strain_____ Quality Control #_____
Location_____ Fish Source_____ Age_____ Case History #_____
Mark/Lot_____ Hat. Date_____ Tissue Collection #_____
Investigator(s)_____ Water Temp._____ Water Hardness_____
Reason for Autopsy_____ Remarks_____

Smp no	Lgth mm	Wght gm	Kid	Eye	Gill	Psbr	Thy	Fat	Spl	Hind Gut	Kid	Liv	Bile	Sex	Hem	Leu	Pl. Pro	Fin	Opl	Remarks
1																				
2																				
3																				
4																				
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GENERAL REMARKS

Fins_____ Gonads_____

Skin_____ Other_____

Figure 2. Fish necropsy worksheet.

10.7.2.2 "Frayed" (F) - This generally refers to erosion of tips of gill lamellae resulting in "ragged" appearing gills. Mere separation of gill lamellae can be construed to be "frayed" but that condition may have been caused by something as simple as the manner in which the gill was exposed by the investigator.

10.7.2.3 "Clubbed" (C) - This refers to swelling of the tips of the gill lamellae. They can often appear bulbous or "club-like". The causes are not pertinent until interpretation is considered.

10.7.2.4 "Marginate" (M) - a graphic description of a gill with a light discolored margin along the distal ends or tips of the lamellae or filaments. Margination can be and often is associated with "clubbing". If both (C) and (M) seem to apply, it is not a problem. It is important that you note that it was not normal. Use the one which seems most appropriate.

10.7.2.5 "Pale" (P) - This refers to gills which are definitely very light in color. Severe anemia can result in gills which are discolored to the point of being white. Severe bleeding induced during sampling of blood can also result in somewhat pale gills. Gills begin to pale somewhat after death also. This is not uncommon in fish taken from nets. All of this should be considered in making the observation.

10.7.2.6 Other (OT) - Any observation which does not fit above. Describe in remarks.

10.7.3 Pseudobranchs (The pseudobranch is located dorsally and anterior to the gills in the branchial cavity and can be easily observed under the opercula.) Some species lack pseudobranchia entirely.

10.7.3.1 Normal (N) - The normal pseudobranch is quite "flat" or even concave in aspect and displays no aberrations.

10.7.3.2 Swollen (S) - The "swollen" pseudobranch is convex in aspect and not difficult to discern upon close examination.

10.7.3.3 Lithic (L) - Mineral deposits in pseudobranchs, manifested by appearance of white, somewhat amorphous spots or foci.

10.7.3.4 Swollen and Lithic (S&L) - Lithic pseudobranchs are often also swollen.

10.7.3.5 Inflamed (I) - This is a generic use of the term, inflamed, and would more appropriately be termed "redness" because it also includes observations of hemorrhage and any other cause of redness. The term, "inflamed" has been traditionally used to describe this condition and is thus contained for that reason.

10.7.3.6 Other (OT) - This term will cover any manifestation observed in the pseudobranch which is not covered in the categories. Be sure to describe in remarks.

10.7.4 Thymus (Assessment of the thymus involves degree of petechial or "pinpoint" hemorrhage).

10.7.4.1 No Hemorrhage (0) - The thymus displaying no hemorrhage is considered to be a normal condition, although this assumption is still under investigation. Caution must be exercised here because when the thymus involutes or ceases to function there is no observable petechial hemorrhage. This happens normally as the fish mature. In salmonids involution of the thymus is thought to happen at two or three years of age but there is considerable disagreement among investigators about this point.

10.7.4.2 Mild Hemorrhage (1) - A few red spots or petechial hemorrhages in evidence. This might be only two or three small spots.

10.7.4.3 Severe Hemorrhage (2) - Many "pin point" hemorrhages in evidence with some of them coalescing. The general area may also have a swollen tumescent appearance but that should be recorded in remarks.

10.7.5 Fins - It must be remembered that this particular assessment procedure is concerned primarily with health and condition. It is not concerned with aesthetic values. Eroded or "ragged" fins are definitely indicative of a departure from normal condition and health. Previously eroded fins which are completely healed over and showing no evidence of the active erosion are, for the purposes of this assessment, considered normal. The evaluation of fins is relative to the degree of active erosion process in evidence. For the purposes of this procedure the number and location of fins involved is not significant. If only one fin is displaying active erosion, the observation must be ranked and recorded. If several fins are displaying erosion with unequal severity, the observation must refer to the most severe in evidence. This unequal nature of the observations, in this case, is less significant in a full 20 fish sample. The classification is as follows:

10.7.5.1 No Active Erosion (0) - Normal appearing fins with no active erosion. This would include previously eroded fins which were completely healed over.

10.7.5.2 Mild active erosion (1) - Active erosion process but no hemorrhage or secondary infection in evidence.

10.7.5.3 Severe Active Erosion (2) - Active erosion with hemorrhage and/or secondary infection in evidence.

Note: Make a general remark relative to which fins were involved and any other observation of special significance. There is a space for this type of entry at the bottom of the data collection worksheet. This is particularly important in the summary.

10.7.6 Opercles (It is necessary only to observe the degree of shortening of the opercles. The classification is as follows:)

10.7.6.1 Normal Opercle (0) - No shortening; gills completely covered.

10.7.6.2 Slight Shortening (1) - Slight shortening of the opercle with a very small portion of the gill exposed

10.7.6.3 Severe Shortening (2) - Severe shortening of the opercles with a considerable portion of the gill exposed.

10.8 **Internal Examination (or Necropsy)**

10.8.1 Figure 3 reveals the key internal anatomical features of a typical soft-rayed fish (brook trout), and Figure 4 displays the anatomical features of a characteristic spiny-rayed fish (largemouth bass).

10.8.1.1 If the fish was not "opened" as suggested above, it should be done now to permit access to the internal systems. Remember to proceed, where possible, in the order listed on the data sheets. This facilitates recording. The order was established beginning posteriorly with the mesenteric fat depot, proceeding anteriorly through the spleen and hindgut, to the kidney, liver, and gall bladder, to the gonads for determination of gender and state of development. At this point, it is wise to observe the mesentery tissue for hemorrhage or inflammation and record in remarks if not normal.

10.8.2 Mesenteric Fat

10.8.2.1 The ranking of mesenteric fat depot has been developed around salmonid fishes with prominent pyloric caeca. It must be noted here that there is great variation among the different fish species in the way that they store this fat. If the system is to be applied to other groups of fishes, alternate ranking criteria will have to be developed. It should be further noted that as long as the ranking is 0 through 4 the computer program, AUSUM, for summarizing data, can still be used. The following ranking system was developed for the rainbow trout but has been applied with minor variations to all major groups of salmonids.

0 - No fat deposited around the pyloric ceca. If there is no fat deposit in evidence anywhere in the visceral cavity it is clearly a "0" fat.

1 - Slight, where less than 50% of each cecum is covered with fat. There are cases where there will be no fat in evidence on the ceca, but there will be a slight fat currently classes as a "1".

2 - 50% of each cecum is covered with fat.

3 - More than 50% of each cecum is covered with fat.

4 - Pyloric ceca are completely covered by a large amount of fat.

10.8.3 Spleen

Black (B) - The "black" is actually a very dark red color of the spleen.

Red (R) - Red coloration of the spleen. There is subjective variation among

investigators as to whether the spleen is black or red, but both conditions are considered normal

Granular (G) - Granular or "rough" appearance of the spleen.

Nodular (NO) - The spleen contains or manifests fistulas or nodules of varying sizes. These are often cysts, such as those encountered with mycobacterial infections.

Enlarged (E) - Spleens can, on occasion, be significantly and noticeably enlarged.

Other (OT) - Occasionally there are observable, gross aberrations which do not fit the above. There may be spleens with a gray mottling and some with very small spleens. These should be classed as "other" and described in remarks.

10.8.4 Hindgut

10.8.4.1 A short distance of the hind gut should be "opened". This should, in fact, have been accomplished as mentioned above when the body cavity is incised. If not, it must be opened to expose the "inner lining" or mucosa. Using the handle of a forceps or some other appropriate blunt instrument, lightly "scrape" out the contents of the hindgut so that you can observe relative reddening or inflammation.

No inflammation (0) - No inflammation or reddening of the hindgut.

Slight inflammation (1) - Mild or slight inflammation or reddening of the hindgut.

Severe inflammation (2) - Considerable, severe inflammation or reddening of the high gut.

10.8.5 Kidney

Normal (N) - Good firm dark red color lying relatively flat dorsally in the visceral cavity along the length of the ventral surface of the vertebral column. It will be necessary to pull the swimbladder and some of the mesentery aside to expose the kidney to view.

Swollen (S) - Enlarged or swollen wholly or in part.

Mottled (M) - Gray discoloration, mottled or "patchy" in appearance ranging from scattered patches of gray to total gray discoloration. This is not to be mistaken with the superficial gray appearance induced by the mesenteric membrane on the surface of the kidney. This should be moved aside before observation is recorded.

Granular (G) - The kidney may have a "granular appearance and texture. This may be induced by granulomatous concretions.

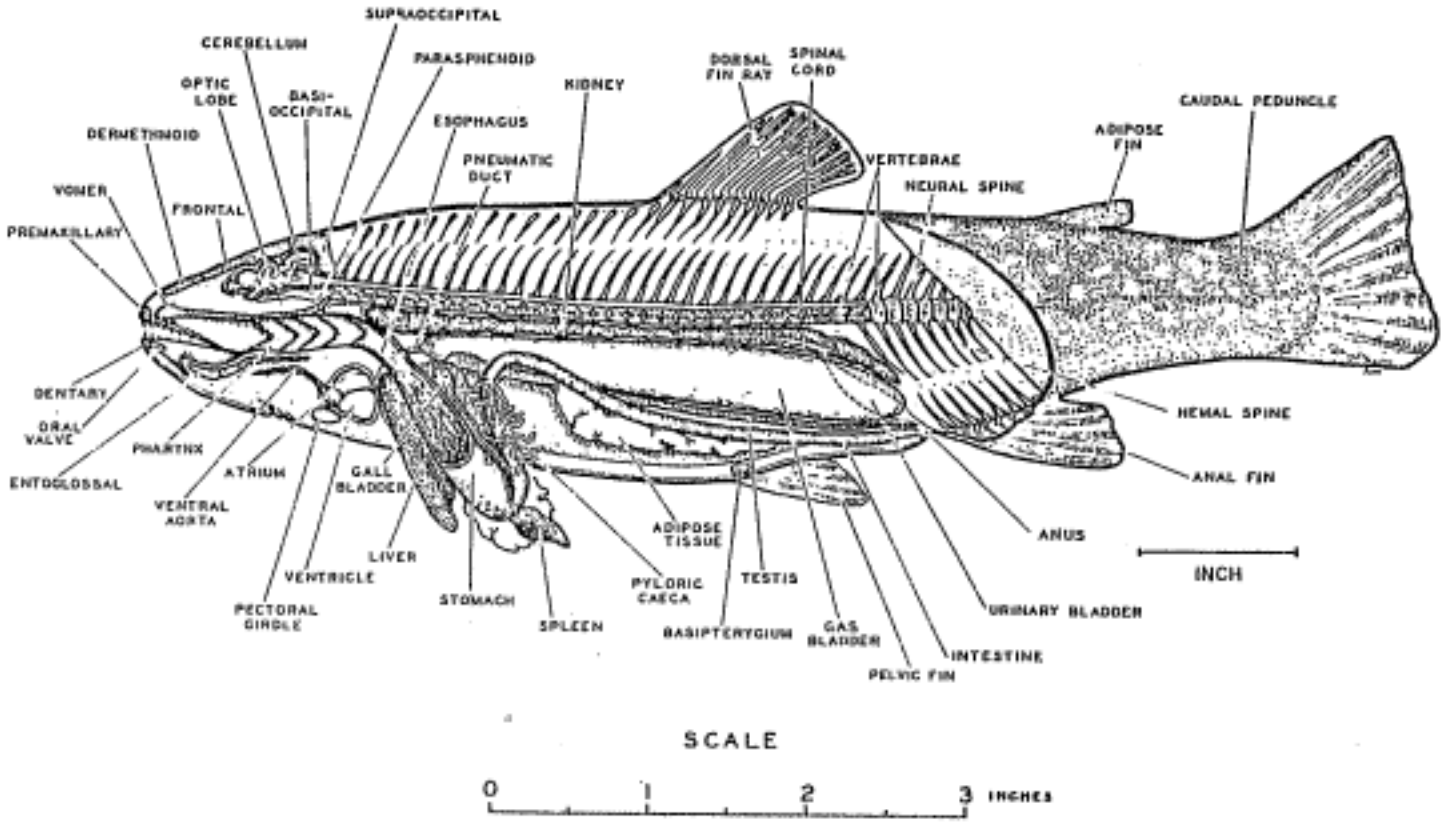

Figure 3. Anatomy of a soft-rayed bony fish, the brook trout, *Salvelinus fontinalis*. From Lagler (1962), Atlas of Fish Anatomy, Plate IV, Michigan Fisheries No. 5, Department of Fisheries, School of Natural Resources, The University of Michigan, Ann Arbor, MI.

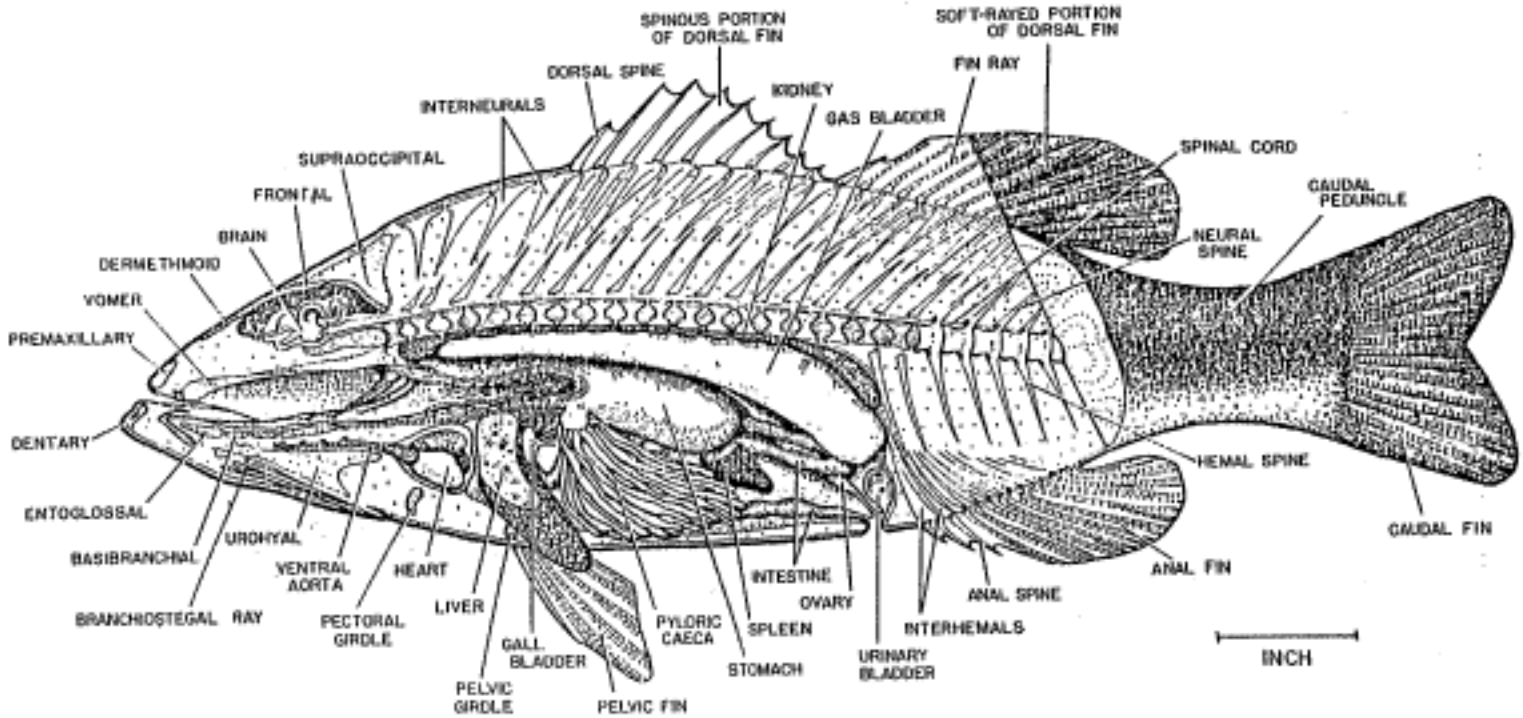

Figure 4. Anatomy of a spiny-rayed bony fish, the largemouth bass, *Micropterus salmoides*. From Lagler (1962), Atlas of Fish Anatomy, Plate V, Michigan Fisheries No. 5, Department of Fisheries, School of Natural Resources, The University of Michigan, Ann Arbor, MI.

Urolithiasis (U) - This condition is known as nephrocalcinosis and involves deposition of a white or "cream-colored" amorphous mineral material in the tubules of the kidney. It can range in appearance from very small white spots to severe involvement with very large "serpentine" deposits. These sites of deposition are not to be confused with the Stannius bodies or corpora of Stannius which are present in salmonid kidneys and have an endocrine function. The Stannius bodies are generally not associated with the tubules and usually occur at the "edges" in an area about midway along the kidney. They appear more globular than do the urolithic deposits.

Other (OT) - This is used to class any aberrations which do not fit into the above scheme. Record it as T and describe it in the remarks.

10.8.6 Liver

10.8.6.1 The appearance of the liver can very well be an artifact of the sampling and the investigator should take that into consideration. Appearance may, for example, vary with the length of time from collection to observation. It also depends to a certain extent on the nature and extent of the loss of blood during sampling. For this reason, categories "A" and "B" are both considered as normal.

A - Normal. Good solid red color.

B - Lighter or less vivid red color than in A. Not so pale as to be classed as general discoloration. Still considered to be normal.

C - "Fatty" liver. Light tan color, such as "coffee with cream".

D - Nodules in the liver, i.e., white mycobacterial cysts and incipient nodules, such as those in hepatoma.

E - Focal discoloration. Color change in the whole liver.

OT - Aberration or deviation in liver which does not fit into above scheme. Class as OT and describe in remarks.

10.8.7 Bile

10.8.7.1 The bile is observed indirectly through observation of the color of the gall bladder. The ranking scheme considers "fullness" of the bladder and degree of "green".

0 - Yellow or straw color; bladder empty or only partially full.

1 - Yellow or straw color; bladder full, distended.

2 - Light green to "grass" green.

3 - Dark green, dark blue-green.

10.8.8 Sex

10.8.8.1 Observation of the gonads when possible should permit determination of gender of the fish. It is also recommended that a remark be entered if the fish are "ripe" or approaching spawning condition.

Male (M) - Observation of testes

Female (F) - Observation of ovaries

10.8.9 General Observations and Remarks

10.8.9.1 Anything which appears to be abnormal should be noted. It is recommended that the mesenteric tissues in the visceral cavity be checked for hemorrhage and inflammation and if these conditions are present, they should be so noted in general remarks.

10.9 Calculation and Summary of Fish Health and Condition Assessment

10.9.1 Now that the fish have been sampled, examined, and as the observations have been made and recorded on the worksheets, all the necessary calculations should be made and summarized.

10.9.2 The format for "Summary of Fish Necropsy" is presented in Table 3. That form will be used for the purpose of this discussion. The section dealing with the heading information will be discussed in a later section, as will the use of the computer. It is more than helpful to use a pocket calculator which is provided with a function for standard deviation.

Ktl - The values of "K" (= coefficient of condition for the metric system) have been used widely by fishery biologists to express the relative robustness of fishes. Also, the values of "K" have been used additionally for age and growth studies to indicate the suitability of an environment for a species by a comparison of the value for a specific habitat with that of other aquatic habitats. The value for Ktl is actually expressed here as Ktl x 10^5. This was done to mitigate the problem of carrying a large number of decimal places in the records. The equation used to obtain the value is as follows:

$$Ktl \times 10^5 = \frac{W \times 10^5}{L^3}$$

Where W = Weight in grams

L = Total length in millimeters

10.9.3 The condition factor used in the English system is Ctl. This value tends to be used by some fish culturists. Ctl x 10^4 is obtained by multiplying (Ktl x 10^5) bu 3.613.

10.9.3.1 The mean, standard deviation and coefficient of variation are to be calculated for the length, weight, Ktl, hematocrit, leucocrit, and plasma protein.

Mean - The mean is determined by totaling all of the values for the observations and dividing by the number of the observations.

Standard deviation - Indepth discussion of the standard deviation is beyond the scope of this presentation. A pocket calculator equipped with a standard deviation function permits very easy determination of that value. To calculate the value without the aid of such a tool would require a prohibitive amount of time.

Coefficient of variation - This value is defined as the ratio of standard deviation to the mean. To obtain this value, divide the standard deviation by he mean and multiply by 100 to convert the answer to percent. This value expresses variation as percent of the mean. Units are not used. Record the results on the necropsy summary sheet.

10.9.4 Values As Percents Of Total Sample

10.9.4.1 This portion expresses the percent of the total sample constituted by each category. As an example, you can consider the eyes. The number of fish with normal eyes divided by the total number of fish in the sample yields the percent normal and should be recorded. The percent of fish with one blind eye (B1) is calculated in the same manner and so on. This is repeated for each category of organ or tissue observation and results are recorded on the necropsy summary sheet.

10.9.5 Summary of Normals

10.9.5.1 This section of the necropsy summary is included to facilitate easier reading with respect to departure from normal. This also facilitates a more accurate summary for those organs and tissues with more than one category considered to be normal, i.e., liver and spleen. It must be further noted that "0" is considered to be normal with respect to degree of hemorrhage in the thymus and degree of inflammation in the hind gut. "N", when present, is understood to be normal and the percent of the sample is indicated in the value distributions. In these instances, merely carry that figure down to the summary of normals. In the following instances the "normal" is not so readily apparent:

Spleen - Black, red, and granular are all considered to be normal manifestations of spleen condition. If the sample demonstrated 70% black, 15% red, and 15% granular, you would combine these and list 100% normal in the summary tables.

Liver - The A and B categories are both considered to be normal. Combine these normals in the summary or normals.

Thymus - The categories included in the observation of the thymus represent degree of petechial or "pin-point" hemorrhage. It is, therefore, understood that "0" hemorrhage is normal. The percent of fish with "0" thymus is carried down to the section dealing with summary of normals.

Hindgut - Degree of inflammation is being measured here so a reading of "0",

TABLE 3. SUMMARY OF FISH NECROPSY

LOCATION:_____ QUALITY CONTROL #_____

Species:_____ Autopsy Date:_____ Sample Size:_____

Strain:_____ Hatching Date:_____ Age:_____

Mark/Lot:_____ Unit:_____ Case History #:_____

Fish Source:_____ Egg Source:_____

Water Temp.:_____ Water Hardness:_____ Investigator(s)_____

Reason for Autopsy:_____

Remarks:_____

MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length		
Weight		
Ktl*		
Ctl**		
Hematocrit		
Leucocrit		
Plasma Protein		

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl: expressed as Ctl times 10 to the fourth power

VALUES AS PERCENTS OF TOTAL SAMPLE

EYES	GILLS	PSEUD	THY	MES FAT	SPL	HIND GUT	KID	LIV	BILE	FIN	OPER
N	N	N	0	0	B	0	N	A	0	0	0
B1	F	S	1	1	R	1	S	B	1	1	1
B2	C	L	2	2	G	2	M	C	2	2	2
E1	M	S&L	-	3	NO	-	G	D	3	-	-
E2	P	I	x=	4	E	x=	U	E	-	x=	x=
H1	OT	OT		-	OT		OT	F	x=		
H2				x=				OT			
M1											
M2											
OT											

SUMMARY OF NORMALS

				xxxxx					xxxxx		

SUMMARY OF MEANS

xxxxx	xxxxx	xxxxx			xxxxx		xxxxx	xxxxx			

SEX M: F: U:

INDEX SUMMARY

Fat Index	Gut Index	Normality Index
Bile Index	Opercle Index	Severity Index
Thymus Index	Fin Index	

GENERAL REMARKS

FINS:

SKIN:

GONADS:

OTHER:

indicating no inflammation, would be considered to be the normal. The percent of the sample with "0" is carried down to the summary of normals.

Fins - Degree of active erosion is being measured here so a reading of "0", indicating no active erosion would be considered to be normal. The percent of the sample with "0" is carried down to the summary of normals.

Opercles - The relative degree of shortening of the opercles is being assessed here so a reading of "0", indicating no "shortening", would be considered normal. The percent of the sample with "0" is carried down to the summary of normals. Mesenteric Fat and Bile - There are no normal categories for mesenteric fat deposit and bile.

10.9.6 Summary of Means

10.9.6.1 This Subsection deals only with categories quantifying relative degrees of some manifestation. Those categories involved in this section are thymus, mesenteric fat depot, hind gut, and bile. This appears to be confusing to people but the means are obtained in the usual manner. Total the values in the appropriate columns and divide that total by the number of observations. The "x" listed in the summary section dealing with values as percents of total sample is the mean of the values and should be carried down to the summary of the means. Numerous investigators using these systems have referred to these means as indices, i.e., thymus index, fat index, etc.

10.9.7 Index Summary

10.9.7.1 The fat index and the bile index are the same as the means for those observations as listed in the summary of means. The thymus, gut, fin, and opercle indices are calculated by dividing the mean (listed in the "summary of means") by the highest level possible and multiplying it by 100 to express it as a percent. If, for example, the thymus mean would be .75, one would divide this by 2 (the highest level possible) and multiply by 100 to yield 37.5 percent. This then becomes the thymus index. The severity index is calculated by averaging the thymus, gut, fin, and opercle indexes. The normality index is calculated by averaging the normals as listed in the summary of normals. All of the indices are to be placed in the index summary of the report for clarity.

10.9.8 Miscellaneous Observations

Sex - The relative proportion of gender should be entered if that information is available. Here, as above, merely count the numbers of each category and divide by the number of fish in the sample. If the investigator(s) is unable to determine the gender, be sure to enter "U" for unknown.

General remarks - Any remarks made in the remarks column of the worksheet and any general remarks, the investigator wishes to make should be made in this section. There is a great deal of latitude here. One might, for example, list under "Fins" that 10 fish or 50 percent of fish had badly eroded, bleeding pectoral fins.

10.9.9 Heading Information

10.9.9.1 The information entered into the heading of the worksheet and summary is very important. It is that information which identified the investigation and which ties it into the greater data base which will permit future recall, manipulation, etc. It is very important that standard terminology, abbreviations, ID systems, and cross-referencing be developed and used to facilitate use in a data base. This is particularly true where computers are to be used. It is likely that even more information will be saved in relational data bases to enhance the value of the information. It should be remembered that the worksheet and necropsy summary were developed to be used both in hatcheries and free-ranging populations. This is in evidenced more in the heading information than in any other portion of the investigation. Many of the categories are self-explanatory, but some are confusing enough to require a brief description. The following is a list of categories with brief statements on some of the less obvious:

Location - Site or location of the study, such as Midway Hatchery or Green River.

Quality Control Inspection No. - This is the number assigned to this particular investigation.

Species - Species of fish being investigated. If abbreviations are to be used, they should be standardized, i.e., RBT for rainbow trout.

Strain - Strain of fish under investigation, i.e., Sand Creek.

Necropsy Date - Date the necropsy was performed.

Sample Size - Number of fish in that particular sample.

Age - Age of fish using standard expression, such as months.

Mark/Lot - Identifying mark, such as dye mark or fin clip in free-ranging fish or a production lot number in a hatchery.

Unit - Raceway number in a hatchery or specific station location, such as Little Hole, Green River.

Water Temperature - The temperature of the water at the sampling site.

Fish Source - This generally refers to the original source of fish. The investigation may be on fish in the Green River, but they may have been stocked by a hatchery. The hatchery would be listed as the fish source in this case. If they were natural reproduction, the Green River would be listed as the fish source.

Egg Source - This refers to the original source of the eggs. In the example above, the eggs may have been shipped to the hatchery by a brood station at some other location. That brood station would be listed as the egg source.

Water Hardness - This is expressed as parts per million (ppm).

Investigator(s) - Name of all investigators.

Hatching or Station Date - The date fish samples for collected.

Reason for Necropsy - Indicate reasons; such as research, routine, trouble shooting, etc.

Remarks - Any information which might have an effect on interpretation of results, i.e., fish were electro-shocked and hauled in tub for half an hour or fish were taken in an overnight gill net set.

Tissue Collection No., Disease Survey No., Case History No., and Custody No. - These are all cross-references to other investigations which should be carried in the data base and which might have bearing on interpretation of results.

Purpose Code - Relates somewhat to "reason for Necropsy". It is included because it makes it possible to do better sorts and queries later when working with the assimilated database. It is very important that his be filled in. A single letter coded is used as listed below:

A = Routine quality control inspection

B = Prestocking quality assessment

C = Trouble shooting

D = Research or special investigation

E = Administrative request for quality control

O = Other, make entry in Remarks area

10.9.9.2 Other letters will be included later as we add letters more relevant for fisheries biologists. This is why "O" is used for "other" rather than "F". It is possible in this case to use more than one letter in combination if it seems necessary. It may, for instance, seem appropriate to use AB because the last routine quality control inspection may also be a prestocking quality assessment and may be important in the use of the accumulated database. All of this will be even more useful when viewed along with "Reason for Necropsy" above.

10.9.9.3 The importance of the heading information cannot be overstated. It is not uncommon to find that individuals have not been as diligent as they might have been in achieving this portion of the investigation. It requires only a few minutes more and makes a difference in the preparation of the results. It is also necessary to the retrieval and manipulation of information in data bases. This permits it to move from project significance to program significance.

10.9.9.4 Once completed, the necropsy summary presents a fish health and condition profile of the population of fish sampled (see Tables 4 and 5; Subsection 10.10.2).

10.9.10 Computer

10.9.10.1 This system lends itself very well to spreadsheet analysis and data base management. A computer program has been developed for calculation, summary, and reporting of the fish health and condition assessment necropsy. AUSUM is a template for Lotus 1-2-3®. It requires a copy of Lotus 1-2-3®, version 2.0 or later and an IBM compatible PC with at least a 512 K memory. The report is formatted in such a way that the printer must be capable of 12 characters per inch and 8 lines per inch. It is a very user-friendly template. The computer program is not necessary to use this methodology, but it makes the task much easier, facilitates standard reporting, and provides the basis for a data base. Instructions for using the AUSUM template are given in Subsection 10.10, and a separate 30 page user's manual has been prepared for the AUSUM 2.6 program and is available from Ronald W. Goede, Utah Division of Wildlife Resources, Fisheries Experiment Station, 1465 West 200 North, Logan, UT 84321.

10.10 AUSUM 2.6--Computer Program for the Necropsy-Based Fish Health And Condition Assessment System[2]

10.10.1 INTRODUCTION

10.10.1.1 The computer program is written for Lotus 1-2-3®, version 2.0. It is a large worksheet so a computer with at least 512 K memory is needed. The program calculates and summarizes the information and produces a printed report. The printed report is formatted for 12 pitch and 8 lines per inch. the printer should be capable of this or the report will not fit properly.

10.10.1.2 AUSUM is a computer program that has been specifically designed to supplement the Necropsy-Based Condition Assessment System developed by Ron Goede. The program, which is based on Lotus 1-2-3®, provides a standard report format and facilitates interpretation of the results. The following features are provided:

* Menus for ease of use
* Defined format for data entry
* Capability to process 60 sample records
* Automatic calculation of the condition factor (Ktl) and all summary information
* Summary information produced in report format
* Hardcopy of sample data produced for reference
* Ability to view Summary information prior to printing the report

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[2]Prepared by Ronald W. Goede and Sybil Houghton (1987), Utah Division of Wildlife Resources, Fisheries Experiment Station, Logan, Utah 84321.

TABLE 4. SAMPLE OF FISH NECROPSY COMPUTER SUMMARY REPORT I

SUMMARY OF AUTOPSY

LOCATION: Midway QUALITY CONTROL NO.: M22Y84

Species:	CT	Autopsy Date: 07/26/90	Sample Size: 20
Strain:	CTBL	Age: 13 mos	Tissue Collection No.: NA
Mark/Lot:	22-Y-8		Disease Survey No.: NA
Unit:	11 & 12	Water Temp.: 56 F	Case History No.: NA
Fish Source:	MW	Water Hardness: 550 ppm	Custody No.: NA
Egg Source:	BL	Investigator: Eric	Purpose Code: A
Hatching Date:	07/01/89	Reason for Autopsy:	Regular autopsy
Remarks:	No unusual variables		

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	199.000 mm	22.34 mm	11%
Weight	70.400 gr	25.67 gr	36%
Ktl*	0.890	0.09	11%
Ctl**	3.215		
Hematocrit	37.900	3.03	8%
Leucocrit	0.880	0.41	47%
Plasma Protein	4.130	1.05	25%

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 45%	0 90%	0 0%	B 20%	0 100%	N 100%	A 80%	0 85%	0 90%	0 85%
B1 0%	F 0%	S 55%	1 10%	1 20%	R 75%	1 0%	S 0%	B 20%	1 15%	1 10%	1 15%
B2 0%	C 0%	L 0%	2 0%	2 20%	G 5%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.1	3 45%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0.1	x 0.1
E2 0%	P 0%	I 0%		4 15%	E 0%		U 0%	E 0%	x 0.2		
H1 0%	OT 0%	OT 0%		x 2.6	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	45%	90%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	90%	85%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	2.6	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.2	0.1	0.1

SEX: M: 65% F: 35% U: 0%

GENERAL REMARKS

FINS Some upper caudals nipped

SKIN Clear

GONADS Developing

OTHER #11, 12, 14, 15 twisted intestine

TABLE 4. SAMPLE OF FISH NECROPSY COMPUTER SUMMARY REPORT I (CONTINUED)

Quality Control No. M22Y84

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	242	119	0.84	N	N	S	0	4	B	0	N	A	1	M	36	1	3.8	0	0
2	173	41	0.79	N	N	N	1	2	B	0	N	A	1	M	35	1	4.8	0	0
3	211	72	0.77	N	N	S	0	3	R	0	N	A	0	F	38	1.5	3.8	1	0
4	187	60	0.92	N	N	N	0	3	R	0	N	A	0	F	44	0.5	6.1	0	1
5	183	52	0.85	N	N	S	1	2	R	0	N	A	0	M	37	0.5	3.3	0	0
6	193	65	0.90	N	N	S	0	3	R	0	N	A	0	M	41	1.5	4.6	0	0
7	203	70	0.84	N	N	N	0	3	R	0	N	A	0	F	35	0.5	4.0	0	0
8	222	88	0.80	N	N	N	0	3	B	0	N	A	0	F	44	1.5	5.1	0	1
9	180	53	0.91	N	N	N	0	2	R	0	N	A	0	F	40	0.5	4.0	0	0
10	198	72	0.93	N	N	N	0	3	R	0	N	A	0	M	39	0.5	4.3	0	0
11	178	35	0.62	N	N	S	0	1	R	0	N	A	0	M	39	0.5	2.2	0	0
12	189	50	0.74	N	N	S	0	1	R	0	N	B	0	M	39	0	3.2	1	0
13	210	93	1.00	N	N	N	0	4	R	0	N	A	1	M	37	1	4.8	0	0
14	203	64	0.77	N	N	S	0	1	R	0	N	B	0	M	37	1	3.1	0	0
15	143	22	0.75	N	N	S	0	1	R	0	N	A	0	F	36	1	2.0	0	0
16	185	57	0.90	N	N	S	0	3	B	0	N	B	0	F	31	0.5	3.7	0	1
17	230	122	1.00	N	N	N	0	3	R	0	N	B	0	M	35	1	4.2	0	0
18	215	97	0.98	N	N	S	0	3	G	0	N	A	0	M	36	1.5	6.0	0	0
19	223	96	0.87	N	N	N	0	4	R	0	N	A	0	M	40	1	5.1	0	0
20	212	80	0.84	N	N	S	0	2	R	0	N	A	0	M	39	1	4.5	0	0
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TABLE 5. SAMPLE OF FISH NECROPSY COMPUTER SUMMARY REPORT II

SUMMARY OF AUTOPSY

LOCATION: Green River QUALITY CONTROL NO.: 88-23B

Species:	Cutthroat	Autopsy Date: 7-6-88	Sample Size: 60
Strain:	Bear Lake	Age: 14 mos	Tissue Collection No.: NA
Mark/Lot:	15Z6		Disease Survey No.: NA
Unit:	Little Hole	Water Temp.: 50 F	Case History No.: NA
Fish Source:	Whiterocks	Water Hardness: 260 ppm	Custody No.: NA
Egg Source:	Egan	Investigator: Barton,	Purpose Code: D
Hatching Date:	4-23-87	Reason for Autopsy:	Green River Project
Remarks:	Plasma samples: A403 to 414		

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	222.330 mm	20.69 mm	9%
Weight	117.620 gr	39.81 gr	34%
Ktl*	1.070	0.94	88%
Ctl**	3.866		
Hematocrit	40.710	4.89	12%
Leucocrit	1.690	0.51	30%
Plasma Protein	6.660	0.72	11%

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 43%	0 20%	B 27%	0 83%	N 100%	A 12%	0 63%	0 47%	0 77%
B1 0%	F 0%	S 0%	1 52%	1 40%	R 73%	1 17%	S 0%	B 88%	1 30%	1 35%	1 13%
C2 0%	C 0%	L 0%	2 5%	2 7%	G 0%	2 0%	M 0%	C 0%	2 7%	2 16%	2 10%
E1 0%	M 0%	S&L 0%	x 0.6	3 25%	NO 0%	x 0.2	G 0%	D 0%	3 0%	x 0.7	x 0.3
E2 0%	P 0%	I 0%		4 8%	E 0%		U 0%	E 0%	x 0.4		
H1 0%	OT 0%	OT 0%		x 1.6	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	43%	xxxxxxx	100%	83%	100%	100%	xxxxxxx	47%	77%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.6	1.6	xxxxxxx	0.2	xxxxxxx	xxxxxx	0.4	0.7	0.3

SEX: M: 62% F: 38% U: 0%

GENERAL REMARKS

FINS Left pelvic fin clipped; avg. fin index = 0.7

SKIN Red dye marked

GONADS NA

OTHER 3 fish w/mild inflamation of hind gut

TABLE 5. SAMPLE OF FISH NECROPSY COMPUTER SUMMERY REPORT II (CONTINUED)

Qual. Control No. 88-23B

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	209	74	0.81	N	N	N	1	0	R	0	N	B	0	F	38	1	6.8	2	1
2	220	90	0.85	N	N	N	0	0	R	0	N	B	0	M	44	1.5	7.1	2	1
3	195	68	0.92	N	N	N	0	1	B	0	N	B	1	F	42	1.5	6.1	1	1
4	207	81	0.91	N	N	N	1	1	B	1	N	B	1	M	46	1	7.3	0	1
5	210	79	0.85	N	N	N	1	0	R	0	N	B	0	M	42	1.5	6.0	2	1
6	214	86	0.88	N	N	N	0	1	R	0	N	B	0	M	40	1.5	6.5	0	2
7	221	89	0.82	N	N	N	1	1	R	0	N	B	0	M	41	2	7.0	1	2
8	210	85	0.92	N	N	N	1	1	R	0	N	B	1	M	38	2	6.8	0	2
9	219	85	0.81	N	N	N	1	1	R	0	N	B	1	F	42	2	6.1	2	2
10	215	82	0.83	N	N	N	0	1	R	0	N	B	0	F	45	1.5	6.4	1	1
11	195	60	0.81	N	N	N	0	0	R	0	N	B	0	M	41.5	2	5.7	1	2
12	195	63	0.85	N	N	N	0	0	R	0	N	B	0	M	37	2	7.1	0	1
13	226	111	0.96	N	N	N	1	1	R	0	N	B	0	M	38	2.5	6.6	1	2
14	230	99	0.81	N	N	N	0	1	R	0	N	B	1	M	41	2	5.8	0	1
15	222	98	0.90	N	N	N	1	1	R	0	N	B	1	F	36	2	6.0	0	0
16	223	102	0.92	N	N	N	1	1	R	1	N	B	1	F	40	1	7.0	2	0
17	205	70	0.81	N	N	N	0	1	B	0	N	B	0	M	52	1.5	6.9	2	0
18	208	69	0.77	N	N	N	1	0	B	1	N	B	0	F	47	1	6.1	0	0
19	230	116	0.95	N	N	N	1	1	R	0	N	B	1	F	36	1.5	6.0	2	0
20	203	75	0.90	N	N	N	0	3	R	1	N	A	1	M	41	2	6.7	2	0
21	218	89	0.86	N	N	N	0	0	R	0	N	B	0	M	37	2.5	6.3	0	0
22	235	114	0.88	N	N	N	0	1	B	0	N	B	0	F	38	2.0	6.6	1	0
23	233	116	0.92	N	N	N	0	1	R	1	N	B	0	M	34.5	2.5	6.2	0	0
24	238	121	0.90	N	N	N	2	1	B	0	N	B	1	M	36	2.0	6.3	1	0
25	232	108	0.86	N	N	N	0	0	B	0	N	B	0	F	33	1.5	6.1	1	0
26	270	186	0.94	N	N	N	1	2	R	0	N	B	0	M	42	2.0	6.0	2	0
27	255	136	0.82	N	N	N	0	0	R	0	N	B	0	F	42.5	2.0	6.5	1	0
28	225	99	0.87	N	N	N	1	1	R	0	N	B	0	F	36.5	2.5	6.4	1	0
29	226	105	0.91	N	N	N	1	1	R	0	N	B	0	F	40	2.5	7.0	0	0
30	251	151	0.95	N	N	N	1	2	R	0	N	B	0	M	35.5	2.0	6.7	1	0
31	232	112	0.90	N	N	N	0	2	B	0	N	B	0	M	38	2.0	6.0	1	0
32	220	93	0.87	N	N	N	1	1	R	1	N	B	1	F	35	2.0	5.9	2	0
33	217	82	0.80	N	N	N	1	1	R	0	N	B	0	M	37	2.0	5.5	1	0
34	227	101	0.86	N	N	N	1	1	R	0	N	B	0	M	37	1.5	6.5	1	0
35	209	81	0.89	N	N	N	0	1	R	1	N	B	1	F	37.5	2.5	7.1	1	0
36	230	115	0.95	N	N	N	0	1	R	0	N	B	0	M	33	1.5	5.0	1	0
37	217	91	0.89	N	N	N	1	0	B	0	N	B	0	F	34	2.0	6.5	2	0
38	207	78	0.88	N	N	N	1	1	R	0	N	B	0	F	34	2.0	7.1	1	0
39	205	75	0.87	N	N	N	0	0	R	0	N	B	0	M	41	1.5	6.7	1	0
40	220	90	0.85	N	N	N	1	0	R	1	N	B	1	F	41	2.0	6.3	1	0
41	236	187	1.42	N	N	N	0	4	R	1	N	B	0	M	46	0.5	7.9	0	0
42	215	128	1.29	N	N	N	1	3	R	0	N	A	0	M	49	2.0	7.1	1	0
43	232	153	1.23	N	N	N	1	3	R	0	N	B	2	F	41	1.0	6.8	0	0
44	247	200	1.33	N	N	N	2	3	B	0	N	B	2	M	41	1.0	7.0	0	0
45	232	169	1.35	N	N	N	0	3	B	0	N	A	0	F	49	1.0	9.4	0	0
46	227	153	1.31	N	N	N	1	3	B	0	N	B	1	M	46	1.0	8.1	0	0
47	236	200	1.52	N	N	N	0	3	R	0	N	B	1	F	40.5	0.5	8.1	0	0
48	218	169	1.63	N	N	N	1	3	R	0	N	B	1	M	44	1.0	7.0	0	0
49	234	153	1.19	N	N	N	1	3	R	0	N	B	2	M	42.5	1.5	7.2	0	0
50	241	172	1.23	N	N	N	1	4	R	0	N	A	0	M	45	2.0	7.1	0	0
51	241	133	0.95	N	N	N	0	4	B	0	N	B	0	M	39	2	6.7	0	0
52	234	164	1.28	N	N	N	1	2	R	0	N	B	0	M	41	2	6.3	0	0
53	250	210	1.34	N	N	N	1	3	R	0	N	B	2	M	30	1.5	5	0	0
54	210	175	1.89	N	N	N	2	3	R	0	N	B	0	M	44	1	7.3	0	0
55	220	162	1.52	N	N	N	0	3	B	0	N	B	0	F	43.5	1	7	0	0
56	215	162	1.63	N	N	N	1	3	R	0	N	A	0	M	46	1.5	7.1	1	0
57	250	107	0.68	N	N	N	1	3	B	0	N	B	0	M	50	2	7.4	0	0
58	223	141	1.27	N	N	N	0	3	R	0	N	B	0	M	49	2.5	7.1	0	0
59	115	123	8.09	N	N	N	0	4	R	0	N	A	1	F				0	0
60	240	171	1.24	N	N	N	0	4	B	1	N	A	1	M	45.5	1.5	6.8	0	0

Prior to use of AUSUM, the following Subsections should be read by all users:

INTRODUCTION
COMPUTER REQUIREMENTS
BEGINNING STEPS
PRINTER SETUP
MENU PRINTER
MACRO PRIMER
AUSUM PROGRAM USE
OTHER PROGRAM SELECTIONS

10.10.1.3 Keyboard Primer (page 279) is provided for those who are not familiar with computers. Lotus Primer (page 280) gives background information for those who are unfamiliar with Lotus 1-2-3®. Entry Requirement (page 284) lists the data-entry requirements. Sample reports are provided (see pages 262-265, 286-287).

Keyboard Primer is provided for those who are not familiar with computers. **Lotus Primer** gives background information for those who are unfamiliar with Lotus 1-2-3®. **Entry Requirements** lists the data-entry requirements.

COMPUTER REQUIREMENTS

AUSUM has been designed for the following computer configuration:

2 floppy disks

IBM PC or compatible with at least 512 K memory

Lotus 1-2-3®, version 2.0

Epson dot matrix printer (see Printer Setup, page 267) for instructions to change the print setup to accommodate other printers.

BEGINNING STEPS

The AUSUM master disk is to be kept for backup purposes only. Before using AUSUM, you need to copy the program onto your own formatted disk. You will also need a formatted disk for a data disk. Use the following instructions to format your disks and copy the program disk:

A. Format a new disk.

1. Place the DOS system disk in drive A.

2. Place the new, unformatted disk in drive B.

3. At the A> prompt, type:
   FORMAT B: (Then press Return key)

B. Copy the AUSUM master disk.

1. Place the AUSUM master disk in drive A.

2. Place a formatted disk in drive B.

3. At the A> prompt, type:
   COPY *.* B: (Then press Return key)

4. Store the original AUSUM master disk in a safe, dry place. This disk should never be used to run the program.

C. Follow Step A directions to format a new disk to be used for your data disk.

PRINTER SETUP

AUSUM has been designed to use an Epson dot matrix printer. The reports are designed to be printed using elite type (12 pitch), 8 lines per inch; thus, the program uses the following command (setup string):

\027\077\0270

Should your printer need a different setup string for elite type, 8 lpi, you may use the Print Set option from the Submenu of the AUSUM program. You will be asked to enter the elite, 8 lpi, setup string for your printer. Simply enter the correct setup for your printer, and the program will automatically setup the printer command for you.

MENU PRIMER

There are two menus for AUSUM:

Main Menu and Submenu

To activate the Main Menu, press Alt-M. To go the Submenu, select the Submenu option from the Main Menu.

Selections may be made from the menus by either of the following methods:

(1) Press the beginning letter of the desired selection, such as H for Heading
(2) Move the Control Panel cursor to highlight the desired selection,then press ENTER.

The following is a brief description of the menu options:

Main Menu

Heading - Enter heading and general remarks
Data - Enter sample data

Calculate -	Calculate Ktl and summary data
Report -	Print a report and hardcopy of the data
Xtract -	Extract data and heading for later use
Prepare -	Prepare worksheet for new data entry
Load -	Load previously saved data file
Submenu -	Unlock, Printset, Extract-Edit, End Lotus, List files, Summary, and Main Menu

Submenu

Unlock -	Unlock titles
PrintSet	Set elite command for your printer
Main Menu -	Return to Main Menu
End -	End work with Lotus/return to MS-DOS
Summary -	To view summary information
List	List files on data disk
Xtract-Edit -	Extract edited data using previous or new file name

CAUTION: Prior to using the menus, you must be certain to deactivate any commands that are currently in use; in other words, the status indicator CMD must not be showing at the bottom of the screen. (To deactivate the CMD, press Ctrl-Break and the ESC.)

MACRO PRIMER

In Lotus 1-2-3® it is possible to program a set of commands. These programs are called macros. There are four macros which you will be using while entering the processing the Necropsy (Autopsy) System data. Each of these macros is invoked by pressing the Alt key simultaneously with the letter that names the macro. For instance, to bring the D macro, press Alt-D. The following is a list of the AUSUM macros, directions for their use, hints about when you will utilize them, and directions to end them:

M - This macro brings the AUSUM Main Menu Control Panel area (top portion) of the screen. (See the Menu Primer, page 267, for an explanation of the menu options.) Use the menu whenever you need to select the next processing step. Press ESC to deactivate the Main Menu. Press ESC twice or press Ctrl-Break and press ESC to deactivate the Submenu.

D - This macro automatically shifts the cursor down to the next cell whenever ENTER is pressed. You will want to use this when entering the Heading Data and any columns in the Sample Data where the entries vary down the column, such as lengths or hematocrits. To end this macro, press Ctrl-Break (you will hear a beep) and the ESC.

C - This macro permits you to copy a specific cell entry to a specified range. You will want to use this when an entire column is all the same entry, such as all N for Eyes. To use this macro, do the following:

(1) Place the cursor on the cell which contains the data to be copied.

(2) Press Alt-C.

(3) Notice a message on the Control Panel will say:

Enter range to copy FROM:

Following the colon will be the current cell location, repeated twice, such as A23..A23.

(4) Press ENTER.

(5) The message will now say:

Enter the range to copy TO:

After the colon, the current cell location will again be repeated twice. (**CAUTION**: Be sure NUM LOCK is off before using the arrow keys to highlight the copy region.) Press the down arrow key to go down the column as far as you want to copy the data. Notice that the copy range is now highlighted. Also notice that the second cell location on the Control Panel has changed as you have moved the cursor. After the desired range is highlighted, press ENTER. **HINT**: If you desire to have two or more columns next to each other with the same entry, such as two columns of N, then highlight both columns by pressing the appropriate arrow keys.

(6) The macro ends itself with no further entry needed from you.

E - This macro will erase a specific range--or even just one cell. This macro must be used with **extreme caution** because you want to erase only incorrect data. To use this macro, do the following:

(1) Place the cursor on the cell to be erased or on the top left corner cell of the range to be erased.

(2) Press Alt-E.

(3) Notice a message on the Control Panel will say:

Enter range to erase:

Immediately following the colon will be the current cell location.

(a) If one cell is to be erased, press Enter.

(b) If a range is to be erased, use the appropriate arrow keys to highlight the range. Be sure you want to erase all the highlighted area! Press ENTER.

(4) The macro will end itself with no further entry needed from you.

HINT: What to do if you begin a macro and something is wrong? You may have entered a wrong character or the mode indicator says ERROR. To end a macro at any time, press Ctrl-Break (you may hear a beep) and then pres ESC. Of the ERROR message shows, you will probably only need to press the ESC key.

HINT: Lotus 1-2-3® will not permit you to use more than one macro at any one time. You will need to deactivate the menu or any other macro before activating a new macro.

AUSUM PROGRAM USE

Program Startup

(1) Start the computer and load with MS-DOS 2.0 or later version.

(2) Insert the Lotus 1-2-3® system disk in drive A.

(3) At the A> prompt, type 123 and then press ENTER.

(4) As soon as the Lotus 1-2-3® program is loaded (The worksheet format will show on the screen), remove the Lotus 1-2-3 system disk and insert your copy of AUSUM in drive A.

(5) Insert the formatted data disk in drive B.

(6) To being the program, type: /FR (The file name, AUSUM, will be highlighted on the third line of the Control Panel).

(7) Press ENTER. The screen will then appear as Figure 1.

(8) Press **ENTER** as directed, and the screen will then appear as in Figure 2.

Figure 1. Introduction to AUSUM

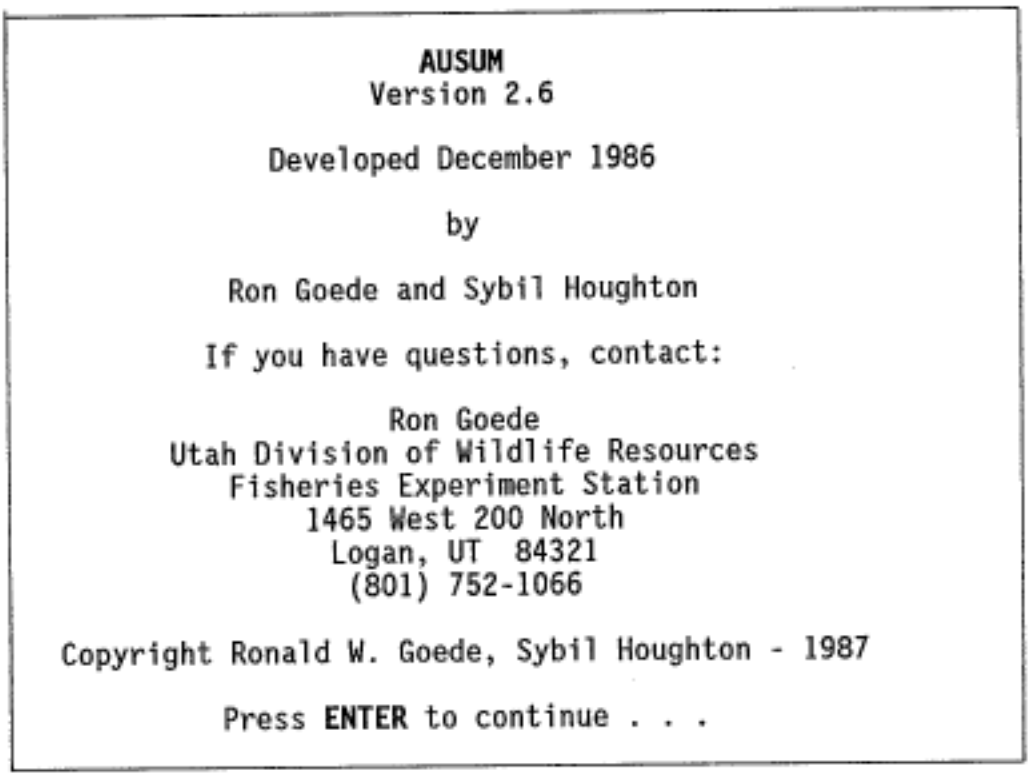
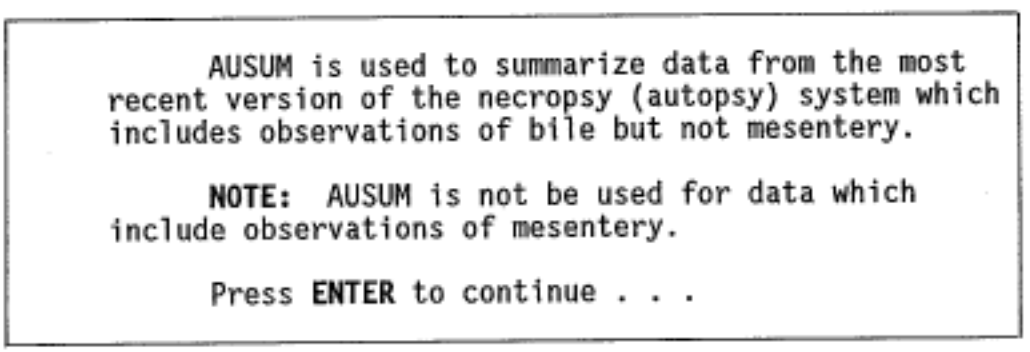
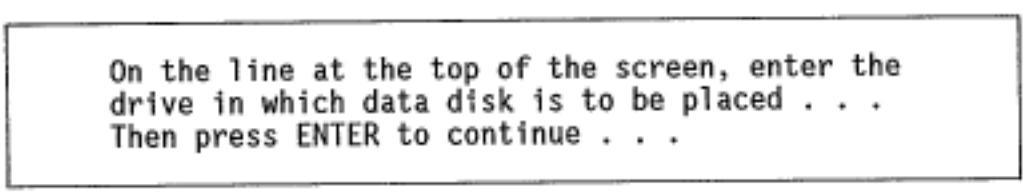


Figure 2. Continuation of Introduction



(9) Press **ENTER** as directed, and the screen will then appear as in Figure 3.

Figure 3. Data Disk Drive Entry Screen



(10) Enter the letter for the drive in which the data disk is to be placed. (for a configuration with two floppy disk drives, you will enter B for the drive letter.)

(11) Then press **ENTER** to continue. The screen will then appear as in Figure 4. You are now ready to begin entering the Heading information. See Program Order (page 273) for steps to follow when using the AUSUM program. The cursor is already located for the first entry.

Figure 4. Beginning Screen

```
D67:  [W10]                                                    READY

 A      B       C       D      E
 64 Enter the heading data in column D
 65    using the specified field lengths {  }:
 66
 67 Location:                    {30}
 68 Species:                     {13}
 69 Strain:                      {13}
 70 Mark/Lot:                    {'13}
 71 Unit:                        {17}
 72 Fish Source:                 {8}
 73 Egg Source:                  {8}
 74 Date of Hatching"            {'MM-DD-YY}
 75 Remarks                      {68}
 76 Necropsy Date:               {'MM-DD-YY}
 77 Age:                         {10}
 78 Water Temp.:                 {2}
 79 Temp. Scale (C or F):        {1}
 80 Water Hardness:              {4}
 81 Investigator:                {15}
 82 Reason for Necropsy          {30}
 83 Qual. Control No.:           {'7}
 84 Sample size                  {2}
 85 Tissue Collection No.:       {'7}
 86 Disease Survey No.:          {'7}
 87 Case History No.:            {'7}
 88 Custody No.:                 {'7}
 89 Fins:                        {65}
 90 Sins:                        {65}
 91 Gonads:                      {65}
 92 Other:                       {65}
 93 Purpose Code:                {2}
```

Program Notes

Before you begin to use the program, read the following notes:

(1) When you begin the program , the cursor is already in position for you to enter the heading data.

(2) You are instructed to enter the data column D according to the specific directions given. There are three types of directions:

(a)	{'MM-DD-YY}	Enter dates, such as '12-06-86. You must use the apostrophe (') in front of the date. (For explanation, see Label/Value section of the Lotus Primer, page 280.)
(b)	{13}	The number (13) indicates the maximum number of characters allowed.
(c)	{'7}	A number used as a label. You must use the '. The number (7) shown indicates the maximum number of characters allowed in addition to the apostrophe. Example: '86-02-1

(3) When the Main Menu us activated, the selections will be displayed on the Control Panel (top portion of the screen).

Program Order

The usual order of menu selections when entering a set of data for the first time is:

(1) Heading
(2) Data
(3) Calculate
(4) Report
(5) Xtract
(6) Prepare

Heading

To enter the Heading information, use the following directions:

(1) Invoke the Down macro by pressing Alt-D.

(2) Enter the information in the appropriate cells.

(3) If there is no information for a particular cell.

To correct entries, do one of the following:

(1) Use the down or up arrow keys to move to the appropriate cell. They type the correct entry.

(2) If you desire to EDIT the entry, do the following:

(a) Move to the appropriate cell.

(b) Deactivate the Down macro by pressing Ctrl-Break and then ESC.

(c) Press the F2 key to EDIT.

(d) Edit the entry line.

(e) Press ENTER.

After all the Heading information has been entered, do the following:

(1) Deactivate the Down macro by pressing Ctrl-Break and then ESC.
(2) Activate the Main Menu by pressing Alt-M.

Data

After you select Data from the Main Menu, the cursor is located in the first cell of the length column. In this area of the worksheet, you may want to enter data in either of the two following ways:

(1) Use the Down macro (see page 268) and enter data in the individual cells as you go down the column.

(2) Use the Copy macro (see page 268) if the column entries are all the same.

NOTE: The first cell of the Ktl column says ERR. This is not a mistake or error! The cell contains the formula to calculate the Ktl. During the calculation process, the formula will be copied down the column and the Ktl will be calculated for each item in the sample. Thus, no entry is required for the Ktl column. (The Ktl column is **not** protected; thus, be careful that you **do not** enter the data in that column.)

To help you with the data entry, the column titles and sample numbers have ben "locked" in place. Thus, as you work you way down and across the worksheet, you will always know the title of the column and number of row for your current cell location.

Enter all the sample data before doing any calculations. After all the data is entered, deactivate the Down macro, if necessary.

REMEMBER: The program is designed for a maximum sample size of 60.

Calculate

(1) Activate the Main Menu (Alt-M).

(2) Select Calculate--the calculations will take a minute or so to complete; thus, the screen will say: Please wait . . .

(3) At the end of the calculation process, the Main Menu will again be displayed and you will be asked to make your next selection.

Report

(1) Be sure the printer is on!

(2) Select Report from the Main Menu.

(3) On the Control Panel will be a question:

Has the printer been turned on? (0 or 1)

After checking to see that the printer is turned on, press 1 and the program will continue. If you decide not to print the report, press 0 (zero) and you will be returned to the Main Menu for your next selection.

(4) A second question will then be shown:

Has all the data been entered? (0 or 1)

If you press 0 (zero), the Main Menu will be displayed so you may make the appropriate data entry selection. If you press 1, the program will continue to execute the print commands.

(5) The screen will say: Please wait . . .

The standard formatted report and a hardcopy of the data will then be printed.

(6) At the end of the printing process, the Main Menu will again be displayed and you will be asked to make your next selection.

NOTE: If you want to save the data on the data disk, you must continue with the next step (Xtract); if not, the data will be permanently lost.

Xtract

By selecting this option, you will be saving (Xtracting) only the heading information and the sample data rather than the entire worksheet. (The program has been designed in this manner to conserve space on your data disk). This selection is only for the first time you save (Xtract) the specific set of data. (See **Xtract-Edit** for edited data, page 278).

To save your data entry on your data disk, do the following:

(1) Select Xtract from the Main Menu.

(2) The screen will show:

ENTER THE NAME OF THE FILE TO BE EXTRACTED . . .

(3) Enter the file name (limited to 8 characters) you wish to use for this set of data. As you enter the file name the *.wk1 will disappear from the Control Panel and the file name will appear.

HINT: For easier file name recognition, we suggest you use the specific Quality Control No. (i.e., 87-01) as part of the file name, such as 87AU01. (You cannot use hyphens in a file name.)

(4) At the end of the extraction process, the Main menu will again be displayed and you will be asked to make your next selection.

Prepare

This process will clear the worksheet and prepare it for a new set of data. [**CAUTION:** Be sure you have saved (using the Xtract option) your data before selecting the prepare option!]

(1) Select Prepare from the Main Menu.

(2) No questions to answer--just wait until it is complete.

(3) At the end of the preparation process, the Main Menu will again be displayed and you will be asked to make your next selection. You are now ready to enter a new set of data or load in a previously saved set of data.

HINT: If you are running short on time and do not want to wait for the printer to print the report, or if a printer is unavailable, you may want to skip the Report option and just Xtract (save) the data for now. Then at a later time you may load the data and select the Report option.

OTHER PROGRAM SELECTIONS

List

An additional feature which AUSUM offers is the ability to list the files on your data disk. This List option is helpful for several reasons. First, you may need to know whether the data disk is full before trying to save a new set of data. (A diskette will hold approximately 25 extracted necropsy (autopsy) data files.) Second, it will help you remember the name of the data file that you want to load. To use the List option, do the following:

(1) Select List from the Main Menu.

(2) A list of the files on the data disk will be displayed on the screen.

(3) To end viewing of the file list, press ENTER.

Load

To process and/or edit data that you previously saved, you will need to load that data into the worksheet. [**CAUTION**: Be sure that the worksheet is prepared for new data prior to using the Load option.] **REMEMBER**: You may select the List option to review the names of your data files prior to selecting the Load option.

Place the specific data disk in the drive you selected for the data disk at the beginning of the AUSUM program, and then do the following:

(1) Select Load from Main Menu.

(2) On the screen will be:

ENTER THE NAME OF THE FILE TO LOADED . . .

(3) Type in the appropriate file name.

(4) Press ENTER.

(5) After the data is loaded, the Main Menu will again be displayed and you will be asked to make your next selection.

You may now do any necessary editing using the methods to correct entries described in **Heading** (page 273) and **Data** (page 274). The program may then be continued as if it were the original data entry. [**CAUTION**: Be sure to select Calculate **after** editing and **before** a report is printed. Calculation must be performed each time you re-enter a file and make any changes.]

Unlock

While you are entering the Sample data, the column and row titles are locked into place. To deactivate the locking process, simply select the Unlock option of the Submenu and press ENTER.

End

When you have completed your data entry for AUSUM and are finished with your use of Lotus 1-2-3, select the End option from the Submenu. This will return you to A> prompt of MS-DOS at the system level. [**CAUTION**: Be sure you have saved all your data before you use the End option.]

PrintSet

See **Printer Setup** for an explanation.

Xtract-Edit

When saving (Xtracting) data that has been previously saved, you must use the **Extract-Edit** option--not the Xtract option. To help your memory, you will be reminded of the name of the file which you have been editing. To use this option, do the following:

(1) Select Xtract-Edit from the Submenu.

(2) On the screen will be:

THE NAME OF THE FILE YOU HAVE LOADED IS:

PLEASE ENTER THAN FILE NAME . . . OR YOU MAY CHANGE
TO A NEW FILE NAME . . .

(3) Type in the appropriate file name.

(4) Press ENTER.

(5) At the end of the process, the Submenu will be displayed and you will be asked to make your next selection.

Summary

This option allows you to view the Summary information. You may want to use this option to check the information prior to printing the report. To use this option, do the following:

(1) Select Summary from the Submenu

(2) On the screen will be some of the Summary information. Use the arrow keys to view all of the information.

KEYBOARD PRIMER

You will notice that the keyboard is very similar to that of a typewriter. However, there are some additional keys. A brief description of these additional keys follows:

Functional keys

On the left side (or across the top) of the keyboard are at least 10 keys which are labeled as F1, F2, etc. These keys are pre-programmed by each computer program to have specific capabilities. The only Function key you need to use for this program is the F2 key, which is the Edit key.

Ctrl (Control) Key

This key is used in conjunction with other keys to enact specific directions. An instruction such as Ctrl-Break means to press the Control and Break keys simultaneously.

Scroll Lock/Break Key

This key is used when the instructions call for the Break key. It is used in conjunction with the Control key to abort certain operations in Lotus. The key has many other uses, but that is the only one you will be using for this program. **CAUTION:** If you do not hold the Ctrl and Break keys down simultaneously, the indicator SCROLL may appear at the bottom of the screen. If this happens, press only the Scroll Lock/Break key to erase the SCROLL indictor and then press Ctrl-Break simultaneously.

Alt Key

This key is used in conjunction with any letter key to invoke Lotus macros (programs). For example, Alt-D means to simultaneously press the Alt Key and the letter D. By doing so you would invoke a macro identified by the letter D. Refer to the **Macro Primer** (page 268) for a further explanation.

Number Pad

These keys permit you to efficiently enter numeric data. To invoke the number pad, press the NUM LOCK key. [**CAUTION:** If the number keys have arrows on them, they can be used only as numbers when the NUM LOCK key has been pressed.

The NUM LOCK key is a toggle key; thus, to return to arrow or direction use, press the NUM LOCK key again.

Arrow Keys

Your keyboard may have separate keys with arrows on them, or the arrows may be on the number pad keys. (Be sure to read the caution included in the Number Pad description above.) Use the arrow keys to move the cursor up, down, right or left.

Home Key

This key is located with the arrow keys. While editing a cell entry, you may use this key to go the beginning of the line being edited. [**CAUTION**: Any other time the Home key is used, the cursor will be taken out of the current position to the beginning of the screen. In that case you must return to the menu (press Alt-M), then make you original selection and return to your original position using the arrow keys.]

Del (Delete) Key

While editing a cell entry, you may use this key to delete the character at the same location as the edit-line cursor.

Backspace Key

You may use this key while entering data or when editing. Pressing this key will delete the character just to the left of the cursor location.

End Key

This key is located with the arrow keys. While editing a cell entry, you may use this key to go to the right end of the line being edited.

ESC (Escape) Key

Use this key when you want to end an operation prior to its normal completion. At times you will need to first press Ctrl-Break and then the ESC key to end an operation.

LOTUS PRIMER

Introduction

Lotus 1-2-3^{R} is a spreadsheet-type of computer program. Such a program is based on "cell entries." Picture the worksheet (working area of the program) as a grid with columns named by letters and rows named by numbers. Thus, each "cell" has a specific location such as A1 or X36. (Perhaps you have played the game "Battleship" that is based on this same type of grid identification.) As you enter data in this worksheet, you will be filling a cell with each "piece" of data.

Screen Format

An understanding of Lotus's screen format will be helpful. The Control Panel comprises the top three lines of the screen. When you begin the program, the Control Panel will appear as in Figure 4. The following example is an explanation of the information on the first line:

Information	Explanation
D67	Location of cursor

{W10}	Width of column
READY	Mode of indicator

When using the menus, the selections will be displayed on the second line. The third line will give the explanation for the highlighted menu selection. Use the arrow keys to move the cursor across the second line, and you will see that the third line changes to give the explanation of each menu selection as it is highlighted.

Sometimes the second and third line of the Control Panel will be blank, or there may be a question on the second line of the Control Panel that you will need to answer. At other times you will need to enter the name of a file. Further directives are given in the Menu Primer (page 267).

The lower left-hand corner of the screen, as shown in Figure 4, gives the date and time. The remaining portion of the bottom line is used to tell which "status indicators" are currently in use. This example shows CALC as the current status indicator. While you are running the program, other status indicators may appear, such as NUM, CMD, and CAPS.

The remaining portion of the screen is the actual worksheet area with its column letters and row numbers for reference. All data entry will be made by you in the worksheet area. This is more fully explained within the program directions.

Label/Value

Typical of all computer programs, Lotus 1-2-3 has its own idiosyncrasies. For data entry you must be aware of one particular Lotus requirement. When you type the first character of an entry, Lotus immediately determines whether the entry is going to be a VALUE or a LABEL. (The mode indicator in the top right corner of the screen will change from READY to VALUE or LABEL.) Sometimes this idiosyncrasy can present a problem. For instance, you may want to enter a date as 12-06-85. Lotus assumes this to be a value because the first character is a number. Thus, rather than displaying your entry, Lotus would display -79, the result of 12 minus 6 minus 85! Likewise, if you typed the date as 12/06/85, Lotus would display .02 which is the result of 12 divided by 6 divided by 85!

Fortunately, there is a way to circumvent this "problem." You simply need to begin this entry with an apostrophe, so you will enter '12-06-85. The apostrophe tells Lotus that you want to treat these numbers as a LABEL rather than as a VALUE. Note that as soon as you enter the apostrophe, the READY mode indicator changes to LABEL.

Lotus considers all of the following as indicative of a VALUE entry:

0 1 2 3 4 5 6 7 8 9 + - . $ (

If you desire an entry that begins with one of these characters to be a LABEL instead, you must begin the entry with an apostrophe.

The slash (/) key is reserved for Lotus commands. You will not need to use this key. In fact, it is recommended that you not used this key unless you are familiar with the use of LOTUS. Should you accidentally press this key, you may press the ESC key to negate its effect.

If the first character of an entry is other than those VALUE entries shown above or a slash (/), Lotus assumes the entry us a LABEL. In this case, you do not need to use the apostrophe--Lotus will automatically place it there for you.

Now, what happens if you forget to use the apostrophe? One of two things will happen:

(1) As in the date example above, Lotus will do the calculation instead of accepting your entry as a LABEL. In such a case, you may change the cell entry using either of the following methods:

(a) Edit the cell entry.

(1) Press the F2 key.

(2) Press HOME to go the beginning of the entry line.

(3) Press the apostrophe key.

(4) Press ENTER.

(b) Re-enter the entire cell entry using an apostrophe as the first character.

(2) If you have combined number characters with label characters, such as 80-6C, Lotus will beep and automatically change to the EDIT mode. You may then simply press the HOME key to go to the beginning of the entry line, press ', and then ENTER.

Data Entry Methods

During the program you will be using two different methods for data entry:

(1) To enter data in a single cell, do the following:

(a) Place cursor on cell where data in to be entered.

(b) Type the entry using an apostrophe where appropriate.

(c) Press ENTER.

This is the most efficient methods to use when

entering the Heading information, length and wright columns data, and all other columns where data varies for each sample.

(2) If the entire column is all the same entry, such as all the Eye entries are N or all the Thymus entries are 0 (zero), then it is more efficient to enter the desired character in the first cell of the column and then copy this entry down the column. To do this, use the Copy macro as explained in the **Macro Primer** (page 268).

HINT: If only one or two of the column entries are different, you may still prefer to use the Copy macro. After copying, go to the one or two cells which should be different and enter the particular data using the single cell entry method.

What do you do if you enter incorrect data? You may do either of the following:

(1) For a single cell correction, move the cursor to the appropriate cell and do one of the following:

(a) Type the entire entry again.

(b) Use the EDIT mode (F2 key) to correct the entry.

(2) For a block or range of cells (see definition of range below), you may find it easier to erase the entire range and then re-enter the data. Use the **Erase Macro** to do the erasure (see page 269).

Terminology

To help you understand and use AUSUM, the following Lotus 1-2-3 terms are defined:

Cursor - There ar two types of cursors in Lotus 1-2-3:

(1) In the worksheet area, the cursor is a highlighted area that designates the current cell location. You will move this cursor with the arrow keys when entering data.

(2) In the Control Panel, a blinking line underlines the current location of the cursor.

Macro - A set of special commands that can be executed with one key stroke combination: Pressing and holding down the Alt key while at the same time pressing the key representing the macro's name.

Mode - Displayed in the top right corner of the screen.

Examples are READY, VALUE, LABEL, EDIT, AND MENU. Hopefully, you will not have the ERROR mode! (If you do, press ESC.)

Range - Specific area of the worksheet--one or more cells. It must be a rectangle or square.

Worksheet - The screen area, except of the Control Panel (top three lines) and the status indicator line (bottom line). This is the work area for a Lotus program.

ENTRY REQUIREMENTS

Below is a list of the correct entries to be used for the AUSUM program:

ENTRY	EXPLANATION
	Eyes
N	Normal
B1	One blind
B2	Two blind
E1	One exophthalmic
E2	Two exophthalmic
H1	One hemorrhagic
H2	Two hemorrhagic
M1	One missing
M2	Two missing
OT	Other
	Gills
N	Normal
F	Frayed
C	Clubbed
M	Marginate
P	Pale
OT	Other
	Pseudobranchs
N	Normal
S	Swollen
L	Lithic
S&L	Swollen & lithic
I	Inflamed
OT	Other

ENTRY	EXPLANATION
	Spleen
B	Black
R	Red
G	Granular
NO	Modular
E	Enlarged
OT	Other
	Hind Gut
0	No inflammation
1	Mild inflammation
2	Severe inflammation
	Kidneys
N	Normal
S	Swollen
M	Mottled
G	Granular
U	Urolithiasis
OT	Other
	Liver
A	Normal, red
B	Pale red
C	Fatty
D	Nodules
E	Focal discoloration
F	General discoloration
OT	Other

ENTRY REQUIREMENTS (CONTINUED)

ENTRY	EXPLANATION
	Thymus
0	No hemorrhage
1	Mild hemorrhage
2	Severe hemorrhage
	Mesenteric Fat
0	None
1	Little; <50% coverage
2	50% coverage
3	>50% coverage
4	100%
	Fins
0	Normal
1	Mild active erosion
2	Severe actiave erosion
	Bile
0	Yellow bile; <full bladder
1	Yellow bile; full bladder
2	Green bile
3	Dark blue-green bile
	Sex
M	Male
F	Female
U	Unknown
	Opercles
0	Normal
1	Slight shortening
2	severe shortening

10.10.2 Sample Report (Summary of Necropsy).

LOCATION: Green River QUALITY CONTROL NO.: 88-238

Species:	CUT	Autopsy Date: 7-6-88	Sample Size: 60
Strain:	Bear Lake	Age: 14 mos	Tissue Collection No.: NA
Mark/Lot:	15Z8		Disease Survey No.: NA
Unit:	Little Hole	Water Temp.: 50 F	Case History No.: NA
Fish Source:	Whiterocks	Water Hardness: 260 ppm	Custody No.: NA
Egg Source:	Egan	Investigator: Barton,	Purpose Code: D
Hatching Date:	4-23-87	Reason for Autopsy:	Green River Project
Remarks:	Plasma samples: A403 to 414		

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	222.330 mm	20.69 mm	9%
Weight	117.620 gr	39.81 gr	34%
Ktl*	1.070	0.94	88%
Ctl**	3.866		
Hematocrit	40.710	4.69	12%
Leucocrit	1.690	0.51	30%
Plasma Protein	6.660	0.72	11%

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 43%	0 20%	B 27%	0 83%	N 100%	A 12%	0 63%	0 47%	0 77%
B1 0%	F 0%	S 0%	1 52%	1 40%	R 73%	1 17%	S 0%	B 88%	1 30%	1 35%	1 13%
B2 0%	C 0%	L 0%	2 5%	2 7%	G 0%	2 0%	M 0%	C 0%	2 7%	2 18%	2 10%
E1 0%	M 0%	S&L 0%	x 0.6	3 25%	ND 0%	x 0.2	G 0%	D 0%	3 0%	x 0.7	x 0.3
E2 0%	P 0%	I 0%		4 8%	E 0%		U 0%	E 0%	x 0.4		
H1 0%	OT 0%	OT 0%		x 1.6	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
MI 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	43%	xxxxxxx	100%	83%	100%	100%	xxxxxxx	47%	77%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.6	1.6	xxxxxxx	0.2	xxxxxxx	xxxxxx	0.4	0.7	0.3

SEX: M: 62% F: 38% U: 0%

Index Summary

Fat Index:	1.62	Gut Index	8.3	Normality Index	85.0
Bile Index:	0.43	Opercle Index	16.7	Severity Index	22.9
Thymus index	30.8	Fin Index	35.8		

GENERAL REMARKS

FINS Left pelvic fin clipped;

SKIN Red dye marked

GONADS NA

OTHER 3 fish w/mild inflamation of hind gut

10.10.2 Sample Report (Summary of Necropsy) Continued.

Qual. Control No. 88-23B

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	209	74	0.81	N	N	N	1	0	R	0	N	B	0	F	38	1	6.8	2	1
2	220	90	0.85	N	N	N	0	0	R	0	N	B	0	M	44	1.5	7.1	2	1
3	195	68	0.92	N	N	N	0	1	B	0	N	B	1	F	42	1.5	6.1	1	1
4	207	81	0.91	N	N	N	1	1	B	1	N	B	1	M	46	1	7.3	0	1
5	210	79	0.85	N	N	N	1	0	R	0	N	B	0	M	42	1.5	6.0	2	1
6	214	86	0.88	N	N	N	0	1	R	0	N	B	0	M	40	1.5	6.5	0	2
7	221	89	0.82	N	N	N	1	1	R	0	N	B	0	M	41	2	7.0	1	2
8	210	85	0.92	N	N	N	1	1	R	0	N	B	1	M	38	2	6.8	0	2
9	219	85	0.81	N	N	N	1	1	R	0	N	B	1	F	42	2	6.1	2	2
10	215	82	0.83	N	N	N	0	1	R	0	N	B	0	F	45	1.5	6.4	1	1
11	195	60	0.81	N	N	N	0	0	R	0	N	B	0	M	41.5	2	5.7	1	2
12	195	63	0.85	N	N	N	0	0	R	0	N	B	0	M	37	2	7.1	0	1
13	226	111	0.96	N	N	N	1	1	R	0	N	B	0	M	38	2.5	6.6	1	2
14	230	99	0.81	N	N	N	0	1	R	0	N	B	1	M	41	2	5.8	0	1
15	222	98	0.90	N	N	N	1	1	R	0	N	B	1	F	36	2	6.0	0	0
16	223	102	0.92	N	N	N	1	1	R	1	N	B	1	F	40	1	7.0	2	0
17	205	70	0.81	N	N	N	0	1	B	0	N	B	0	M	52	1.5	6.9	2	0
18	208	69	0.77	N	N	N	1	0	B	1	N	B	0	F	47	1	6.1	0	0
19	230	116	0.95	N	N	N	1	1	R	0	N	B	1	F	36	1.5	6.0	2	0
20	203	75	0.90	N	N	N	0	3	R	1	N	A	1	M	41	2	6.7	2	0
21	218	89	0.86	N	N	N	0	0	R	0	N	B	0	M	37	2.5	6.3	0	0
22	235	114	0.88	N	N	N	0	1	B	0	N	B	0	F	38	2.0	6.6	1	0
23	233	116	0.92	N	N	N	0	1	R	1	N	B	0	M	34.5	2.5	6.2	0	0
24	238	121	0.90	N	N	N	2	1	B	0	N	B	1	M	36	2.0	6.3	1	0
25	232	108	0.86	N	N	N	0	0	B	0	N	B	0	F	33	1.5	6.1	1	0
26	270	186	0.94	N	N	N	1	2	R	0	N	B	0	M	42	2.0	6.0	2	0
27	255	136	0.82	N	N	N	0	0	R	0	N	B	0	F	42.5	2.0	6.5	1	0
28	225	99	0.87	N	N	N	1	1	R	0	N	B	0	F	36.5	2.5	6.4	1	0
29	226	105	0.91	N	N	N	1	1	R	0	N	B	0	F	40	2.5	7.0	0	0
30	251	151	0.95	N	N	N	1	2	R	0	N	B	0	M	35.5	2.0	6.7	1	0
31	232	112	0.90	N	N	N	0	2	B	0	N	B	0	M	38	2.0	6.0	1	0
32	220	93	0.87	N	N	N	1	1	R	1	N	B	1	F	35	2.0	5.9	2	0
33	217	82	0.80	N	N	N	1	1	R	0	N	B	0	M	37	2.0	5.5	1	0
34	227	101	0.86	N	N	N	1	1	R	0	N	B	0	M	37	1.5	6.5	1	0
35	209	81	0.89	N	N	N	0	1	R	1	N	B	1	F	37.5	2.5	7.1	1	0
36	230	115	0.95	N	N	N	0	1	R	0	N	B	0	M	33	1.5	5.0	1	0
37	217	91	0.89	N	N	N	1	0	B	0	N	B	0	F	34	2.0	6.5	2	0
38	207	78	0.88	N	N	N	1	1	R	0	N	B	0	F	34	2.0	7.1	1	0
39	205	75	0.87	N	N	N	0	0	R	0	N	B	0	M	41	1.5	6.7	1	0
40	220	90	0.85	N	N	N	1	0	R	1	N	B	1	F	41	2.0	6.3	1	0
41	236	187	1.42	N	N	N	0	4	R	1	N	B	0	M	46	0.5	7.9	0	0
42	215	128	1.29	N	N	N	1	3	R	0	N	A	0	M	49	2.0	7.1	1	0
43	232	153	1.23	N	N	N	1	3	R	0	N	B	2	F	41	1.0	6.8	0	0
44	247	200	1.33	N	N	N	2	3	B	0	N	B	2	M	41	1.0	7.0	0	0
45	232	169	1.35	N	N	N	0	3	B	0	N	A	0	F	49	1.0	9.4	0	0
46	227	153	1.31	N	N	N	1	3	B	0	N	B	1	M	46	1.0	8.1	0	0
47	236	200	1.52	N	N	N	0	3	R	0	N	B	1	F	40.5	0.5	8.1	0	0
48	218	169	1.63	N	N	N	1	3	R	0	N	B	1	M	44	1.0	7.0	0	0
49	234	153	1.19	N	N	N	1	3	R	0	N	B	2	M	42.5	1.5	7.2	0	0
50	241	172	1.23	N	N	N	1	4	R	0	N	A	0	M	45	2.0	7.1	0	0
51	241	133	0.95	N	N	N	0	4	B	0	N	B	0	M	39	2	6.7	0	0
52	234	164	1.28	N	N	N	1	2	R	0	N	B	0	M	41	2	6.3	0	0
53	250	210	1.34	N	N	N	1	3	R	0	N	B	2	M	30	1.5	5	0	0
54	210	175	1.89	N	N	N	2	3	R	0	N	B	0	M	44	1	7.3	0	0
55	220	162	1.52	N	N	N	0	3	B	0	N	B	0	F	43.5	1	7	0	0
56	215	162	1.63	N	N	N	1	3	R	0	N	A	0	M	46	1.5	7.1	1	0
57	250	107	0.68	N	N	N	1	3	B	0	N	B	0	M	50	2	7.4	0	0
58	223	141	1.27	N	N	N	0	3	R	0	N	B	0	M	49	2.5	7.1	0	0
59	115	123	8.09	N	N	N	0	4	R	0	N	A	1	F				0	0
60	240	171	1.24	N	N	N	0	4	B	1	N	A	1	M	45.5	1.5	6.8	0	0

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